FEBRUARY 20, 1922

AVIATION

VOL. XII. NO. 8.

Member of the Audit Bureau of Circulations

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THE GARDNER, MOFFAT COMPANY, Inc., *Publishers*
HIGHLAND, N. Y.
225 FOURTH AVENUE, NEW YORK

Subscription price: Four dollars per year. Single copies fifteen cents. Canada, five dollars. Foreign, six dollars a year. Copyright 1922, by the Gardner, Moffat Company, Inc.

Issued every Monday. Forms close ten days previously. Entered as second-class matter Nov. 22, 1920, at the Post Office at Highland, N. Y., under act of March 3, 1879.

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AVIATION

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Vol XII FEBRUARY 20, 1922 No 8

Germany and Aviation

THE recent announcement by the Council of Ambassadors that the treaty restrictions on the manufacture of German aircraft are to be lifted on May 5, is one of the most important events of the present period of the development of aviation. Germany has occupied a peculiar position in the development of aircraft ever since 1914. In the construction of lighter-than-aircraft she has excelled the efforts of the rest of the world. This is because she has always placed great confidence in them while the other nations have been somewhat doubtful as to their utility.

In the heavier-than-air field, German designers have been laboring under various restrictions ever since the naval blockade went into effect during the war. The lack of materials forced them to develop many ingenious expedients, while at the same time many valuable lines of investigation were absolutely closed to them. After the war the Allied aircraft prohibition that has been in effect until Germany complied with her treaty obligations, virtually stopped any new construction to date.

The terms of the Versailes Treaty prohibit Germany from having any military aircraft and very greatly limit her sea fleet. The enormous tonnage of merchant marine that she has been required to turn over in payment for the allied and neutral ships wantonly destroyed during the war, has inclined many influential Germans to the view that she will have to take to the air if she is to regain her lost commercial prestige. The combination of these factors has resulted in the production of some remarkable commercial aircraft designs.

There can be no doubt that the various German aircraft manufacturers will attempt to sell airplanes abroad. There are many who feel that the Americas and in particular the United States, are the most promising fields for exploitation. In this country foreign airplanes are subject to a high tariff and are required to pay for patent licenses. It is a serious problem and one worthy of very earnest consideration by all interested in the American industry, whether or not the low operating cost of the German designs will not far outweigh their high first cost, particularly in view of the rate of exchange and the cost of foreign labor. It is certain that from the operating cost standpoint, war surplus machines will be hopelessly outclassed in regard to their use as *transport* machines.

The more general aspects of the revival of competition are also to be debated. There are many people who feel that the removal of the restrictions constitute a menace to civilization on the ground that the machines to be constructed will constitute a potential air force as the manufacturing facilities can be readily diverted to war use. It is an old adage that states that competition is the life of business. There can be no doubt that German competition will greatly stimulate manufacturers both here and abroad toward new developments.

"Results, not Reasons"

AT a meeting of publishers recently held in New York a speaker was emphasizing the value of actions as contrasted with words in all forms of endeavor. He mentioned among others that General Mason M. Patrick, when Chief of the Air Service of the A E F, had a sign over his desk which read: "Results, not Reasons."

At this time, when the Air Service is becoming every day more important as a factor of national defense, it is of interest to know that the present Chief of Air Service has such a forceful and direct slogan. It is hoped that he will not only have a similar card in his Washington office, but that similar signs may be found over many other desks in the Air Service.

Air Surveying

ONE of the greatest advantages that aircraft offer to civil pursuits is that of air surveying. Surveying and mapping play a very important role in modern business despite the present cost. Nearly every transfer of title to land or new construction requires a survey. Large areas of the world are practically unmapped because the cost is much greater than the information is considered worth at the present time. Many times the lack of information brought about by this condition results in serious losses that are not realized until long after the project is completed.

Air mapping is able to furnish accurate information at a cost far below present ground methods. Many times a set of carefully chosen oblique photographs of an area will tell more than the usual preliminary ground survey could ever show. Then a mosaic can be made that will show all the features in their proper places and at the time the survey was made. Many projects have to be laid out from a map that was made many years ago. There are portions of the country that have not been mapped for thirty years.

The principal use of air surveying at the present time is for supplying the up-to-date details on existing maps, such as city planning projects. This is due to the ignorance of the public rather than to any defects in the work. As times goes on the field will widen. One branch of surveying that aircraft are not very active in at present is contour mapping. There are many indications however that several groups are on the way to make this a practical proposition.

Progress in Helicopters

THOSE of our readers who are interested in the possibilities of the helicopter, will find an instructive account of the present state of its development in this issue. The author of the article in question, M. B. Sellers, during the war was a member of the Naval Consulting Board, and in this capacity he has made an exhaustive study of the question. His article affords an excellent introduction to the subject.

Requirements and Difficulties of Air Transport

Former Manager of A. T. & T. Air Line Reviews the Situation In the Light of Three Years' Experience on Channel Service

By Frank Searle

It is not very far from twenty years now since the first airplane propelled by an internal combustion engine was made to fly. The science and the art of aviation received an incredible impetus during the war, and now after three years of peace we have sorrowfully, and perhaps shamefacedly, to acknowledge that we have not yet overcome and mastered the problem of serving mankind by air transport. But, like every other phenomenon, at first glance startling, there is an explanation of this failure, or if you prefer to call it so, the very qualified success of civil aviation. It is our business to end this failure, to complete this success, and I suggest that the right way to begin is to visualize as clearly as we can what are the essential characters of the problem, because when we have analyzed and stated these we shall see clearly what the obstacles are to their being practically met.

Essential Points of the Problem

These requirements are obviously of three kinds. First there are those proper to the vehicle you propose to employ; these group themselves naturally into the requirements of the engine, as a source of power, and the plane, both as a device for rising into the air, staying in the air, and descending from the air to the land in a satisfactory way, and as a commodious and pleasant vehicle for the accommodation of travellers. Next, bearing in mind that it is a question of transport we are considering, there are all the problems involved in bringing travellers from their homes to the flying machine before it starts, and delivering them from the flying machine, after it has arrived, to their final destination. And lastly—and it is these requirements which govern the whole problem—there is the question of giving that rapidity and certainty of service to the customer at a price which he recognizes to represent the advantages offered, and this without the apparatus and the organization costing more than the travellers are able to pay. Stated in another way, then, the requirements fall into three groups which should be called the technical group, the organization group, and the economic group.

The ideal airplane for civil transport must consist of an engine on which the undertakers of the transport service can rely, not only for steady work, but for long work at a reasonable maintenance cost. The vehicle it propels must take the maximum load with the maximum comfort, the limitation in each case being the speed, certainty and safety, without which air transport can never become a commercial success. And the cost and upkeep of both must be reasonable.

Our three years' experience of civil flying since the war show us that there is not in universal use today the engine which meets the requirements I have set out. The explanation is not so much that these requirements have not been understood as that at the time when civil aviation became for the first time a possibility, the argument for experimenting with makeshift gear was irresistible, the attitude of directors and others in aircraft manufacturing firms soon after the time of the Armistice when they, in moments of apprehension, turned their minds to air transport. This apprehension must have been genuine and severe, knowing that the government aircraft orders were ceasing and that something would have to be done, and done quickly, if the huge factories were to exist even on a much smaller scale.

The Airplane's Expensive Origin

It must be borne in mind that at the beginning of the war the science of aviation was so young and the necessity for aircraft so great that both the management and the technical staffs of aircraft manufacturers were intensive productions, and from the beginning of the war to the end of it, were fostered on expensive lines, while at the same time the managements and technical staffs of other and more slowly developed industries were all fully occupied and necessary in their own particular sphere.

Another very great factor was that these intensive staffs were reared in an atmosphere of forced production with very little regard for economy either in personnel or material. It is not very surprising, therefore, that when they made their momentous decision to go into aerial transport they went ahead on what to them was their ordinary business methods, namely, of extravagence in men and material, and, instead of enlisting new men and material, carried on with what existed at the moment.

Their first thought seems to have been to transfer war machines and men to the transport companies, the majority of both being not only unsuitable but detrimental to the very progress they were so anxious to foster. The designers, too, who are the aerodynamic and theoretical people on whom we rely for flying efficiency, had not the advice of people with practical transport experience to guide them as to the requirements of a commercial transport service; they had only the advice of those whose experience was limited to war flying. The tendency of the designers themselves, quite naturally, was also influenced by their experience having been gained, one might almost say entirely, in the design of machines for war purposes. My critics will no doubt say that it is easy to be wise after the event, but if we examine the problem they had to solve it will be admitted that any authority on transport for profit would have provided different men and different machines.

A transport man would have at once gone into the daily overhead charges per machine, in which would be included such ordinary items as depreciation, insurance, interest on capital and management and office charges, and these, plus the net flying cost per mile, would give clearly the number of miles per day per machine which have to be flown in order to break even, assuming the average normal load of other forms of transport.

Making Airplanes Pay

In spite of the ease with which such figures could have been obtained at the time I went into business (which was twelve months after air transport had been established) I was told by one of the highest authorities on flying—a man who had gained a very high reputation during the war, but who had only war experience and no commercial experience—that an airplane could only fly 250 hours a year. This means approximately 70 miles per day; therefore, at 50 per cent load, a four-seater machine, charging 1s. 6d. per mile per passenger, could not possibly earn sufficient to pay its overhead charges—this figure represents an £18 fare to Paris, at which price passengers could not be obtained. Nor could they be obtained at £15. At £10 they began to appear in small numbers, and at £6 we find signs of real interest. In addition to this, not having worked out and appreciated these fundamental figures, firms employed a far greater number of machines than were necessary to obtain even the above unsatisfactory figures. On the other hand, one must not lose sight of the fact that but for their heroic efforts and the colossal loss of their, and other people's, money, civil aviation would not be where it is today, though had they found the money and given the problem to some firm who had been successful for many years in mechanical transport, it could have been today on a much sounder basis than it is.

The operation and maintenance of their machines was carried on with lamentable lack of knowledge. For instance, while they employed a vast number of machines for the services which were maintained and on which the overhead

charges went on daily, there was a very serious shortage of spare parts and spare engines, and, in consequence, machines were lying idle while their engines were being repaired, which meant that they were not only losing their earning capacity but that the overheads of about £4 per day per machine were going on for two or three weeks.

Again, little or no equipment was provided for doing repairs and inspections expeditiously, whereas a small capital outlay in this direction would have saved hundreds of pounds in labor.

Ground Engineer's Licences

Again, none of the executive heads of the concerns held ground engineers' tickets as granted by the Air Ministry. These were all held by mechanics, so the decision as to fitness or otherwise of a machine was in the hands of the workmen, whose word was final. It should, of course, have been imperative that those in charge held the necessary qualifications required by the Air Ministry.

In addition to this, the facilities for carrying on one's work at Croydon were very poor since in many cases the machines of various companies were mixed up in one shed and machines had to be constantly moved about in order to accommodate others arriving at odd times. Also, no bulk gasoline storage tanks were provided, which meant that big quantities of gasoline had to be man-handled in two-gallon tins, whereas a little forethought would have saved all this labor and at the same time saved 1½d. per gallon on the price of the gasoline which, considering the quantities consumed by airplanes, amounts to a considerable sum at the end of a year. The Air Ministry had considered the bulk storage question, but had shelved it owing to the fact that during the next three years they might have had to shift it to a more permanent spot. I mention this to show that the people handling air transport at this time were lacking the commercial touch, since in this case an expenditure of £500 would have saved £750 the first year.

Again, at this period the meteorological information was mostly too late and too meager to be of real service, and the wireless installations were very ineffective. It was the same with the Air Ministry as it was with the companies—they had not the experience to differentiate between the essentials and non-essentials of air transport, and consequently often spent money unwisely from this standpoint. One must admit that the Air Ministry worked exceedingly hard in the interests of air transport, but they were guided by chance and not by experience, and I feel sure there must have been someone in the marine or road transport business who could have given them the guiding principles of their own business which would have been useful in air transport.

In the past air transport companies were in the habit of carrying all their passengers and goods to and from the airdrome (which cost them over £1 per head or 10 per cent of the fare), and also of giving 10 per cent commission to the various travel offices for booking a passenger by air. This again is excessive, and such offices should not expect more from air companies than from railway or steamship companies; in fact, in order to foster the business, they should be prepared to accept less. It is these heavy unnecessary charges that must go, otherwise air transport must fail.

Now with regard to air passenger organization. The circumstances proper to all other forms of transport are proper to transportation by air. Nobody would make a success of the finest and fastest Atlantic steamer service that science can conceive or genius supply if the rapid and luxurious ships, we suppose in existence, started from some inaccessible port in England and arrived at some destination in America extraordinarily inconvenient to those who wish to go to the centers of population. It is not a counsel of perfection, it is simply axiomatic that the airplane, like the express train and like the steamship, is not a self-sufficent vehicle as, for instance, is the motor car. To get to the train you have to use a carriage or car to take you to the station, when you arrive at your train destination you have to have another vehicle to take you home. If you leave England and live in London you have to take a train to the port from which the ship starts. If you arrive in New York and your destination is Chicago, you have to take a train from New York to Chicago. In the first case the carriage and the cab, and in the second case the train service, are integral factors in the journey. Now so far as civil aviation is concerned, we have neither in England nor in Paris a starting and landing point for airplanes which is served by cheap, commodious and punctual train services; for that matter they are not served by train services at all. Secondly, to go back to our first comparison. If you are going from London to Liverpool, and thence from Liverpool to New York, you can drive in a closed carriage to Euston where there is a comfortable station and waiting rooms affording complete protection from the weather, and when you get to Liverpool the train runs alongside the steamer, and you go along a covered gangway to the ship. It is only a few years since the trains started running alongside the ships at Liverpool and other ports, but it was realized what an important advance it would be, and how much such a service would add to the comfort of passengers. You can hardly expect the air service to be as comfortable as the train service until some such amenities as these exist at the starting and landing place. At present there is no means of getting to the aviation ground at Croydon at all except by car, and arrived there, there are neither waiting rooms nor

A recent British commercial airplane. The Bristol ten-seater (450 hp Napier "Lion" engine)

conveniences of any kind for the comfort of the passenger, and he has to walk many hundreds of yards, often through slush and mud, before he reaches the vehicle in which he is to spend two hours nursing his sodden feet to Paris.

I mention only the rudimentary shortcomings of the air service as it exists today, but obviously we cannot hope for flying to be a regular feature of normal travelling life until this form of travelling includes—I will not say the luxuries—but those mere mitigations of discomfort which we all take for granted when travelling by train or steamer.

Importance of Terminal Connections

And here another point must be considered. One of the fundamental troubles in connection with flying today is not only that the traveller has none of the comforts and conveniences that he is accustomed to in other forms of travelling, but he is put to enormously greater expense because of the absence of facilities which surely could be supplied without undue cost or risk. It is, in my opinion, simply absurd that there should not be a regular service of trains to a platform running alongside the plane at the airdrome, so that within a quarter of an hour of saying good-bye to his friends in London the traveller should be seated in his airplane and ready to start, and that there should not exist in Paris a service of exactly the same nature. Apart from all other question, this provision for the comfort of the traveller is an indispensable condition of successful commercial flying.

The question at once arises as to who is going to provide the railway facilities to the airdrome. In the first place, an airdrome should not be chosen which is cut off from the outer world either by distance or lack of communication, and if the ideal airdrome necessitates such glorious isolation, then the Government must subsidize some railway company to provide the necessary connection. But for the Government to choose an isolated spot for an airdrome and then subsidize air transport companies by a subsidy on gross takings from passengers who cannot get there is, of course, absurd.

Now when it comes to the economic side of flying, this obviously is a question of balance between receipt and costs. The circumstances that define the most economical form of ship or train or motor car are the same as those that define the desired features of an economical airplane. The speed must be such as to give an overwhelming advantage over any other form of locomotion. But it must be speed consistent with carrying a considerable load at a running cost which is not excessive, and it must be speed that does not demand either excessive first costs of engines and airplane or excessive upkeep. On these points we have learned a great deal in the last three years, but I venture to say that we should have learned more if the public authority for dealing with flying had been composed of individuals more familiar with the problems as we see them in this room, and less influenced by experience and problems of a totally different nature, namely, those propounded by aviation during the war.

The position of the Air Ministry in air transport is a most important question, and one which ought to be cleared up at once. At the present moment it combines the equivalents of Municipal Authorities, Trinity House, the Board of Trade and Lloyd's, and I will deal with the analogous functions in this order.

Ground Organization

In my opinion the Air Ministry must for the time being continue to act as Municipal Authorities in the way of developing airdromes, and as Trinity House in regard to navigation, but in carrying out these duties every effort should be made to improve the foreign liaison with our neighbors and persuade them forcefully to provide the same facilities on their customs' airdromes as we provide on ours, as well as equal lighthouses on the routes. France has had far more money voted to civil aviation than we, and yet Le Bourget and St. Inglevert are disgracefully organized. The London airdrome should be at least 1200 yd. square, and the adjoining land should be acquired and let out for grazing so as to provide a good take-off in every direction and provide good re-landing possibilities during that period of flight just after taking off. The sheds should be on the lee-side of the airdrome to prevailing winds so as to minimize taxi-ing, which is a serious cost, and one which was given very little consideration during the war by reason of the fact that it was not necessary to count the cost, but I have no hesitation in saying that five minutes of taxi-ing does more damage to a machine than ten hours' flying. Separate accommodations should be provided for each company, with a common shed for "casuals."

If the Air Ministry are to continue to act Trinity House, as they must, they must accept the responsibility of persuading adjoining countries to do likewise, so that night flying may be made as safe as daylight flying. On the Paris route there should be two lighthouses between Croydon and Lympne, and three or four between Paris, Le Plage and Le Bourget.

In regard to the Air Ministry acting as the equivalent of the Board of Trade and Lloyd's in marine matters, I have no objection to their doing the former's equivalent duties, but with regard to the latter I do feel that the time is here for owners, builders and underwriters to get together and form some sort of Lloyd's Committee so as to keep the Air Ministry advised of their requirements. The question is one of the utmost importance. The Air Ministry has not yet the complete confidence of business men, and it is necessary for them to have some reliable source of information as to what regulations are necessary for the protection of all their interests.

Commercial and Economic Experience

There are some very brilliant young men at the Air Ministry who are most thorough and conscientious in their work, but when one deducts their negative commercial and economic experience of the war, one finds that experience with them cannot be expected. And in a few cases, after deducting their negative war experience, they could not have had more than the meager engineering or technical training of an apprentice or pupil.

These men in many cases have the power to dictate as to design and details of operation, and companies have no appeal from their considered opinions which are invariably based upon war experience and R.A.F. training. Every official in the technical branches of the Air Ministry should be an engineer of good training and undoubted experience excluding his war service.

I should also like to mention the examinations for ground engineers. These are verbal examinations, and are therefore the most difficult to organize, and from what I have seen, they have a tendency to follow that unsound policy adopted temporarily years ago in some of the Board of Trade examinations for the marine engineers' tickets—it is that of trying to "catch" the applicant by trick questions instead of thoroughly ascertaining his education, experience and knowledge. An example seen in the Air Ministry was a stretching screw—or turnbuckle—which had both ends screwed to the same hand, and the applicant was asked to examine it and state where it was faulty. I suggest that such "catches" are not a reasonable test either for education, experience or knowledge, which all goes to indicate that the examiners do not quite realize the essential qualifications of the holder of such a ticket, and I consider that the examination papers for the applicant for these tickets should be laid down by the committee to which I have referred.

The wireless on this side is good, but stronger liaison is required with the Continent, where the wireless service even yet, after two years, is still practically useless, and direction finding must be developed to perfection along the whole of the Paris route without delay.

Flying in Thick Weather

Some organization would appear to be necessary for flying in mists and clouds in that on the organized routes machines flying in opposite directions should have different ranges of altitudes. This, I think, is where the Committee previously referred to should make some recommendations, and it is most important that the meteorological office should collect information from machines in the air and distribute it within a few minutes, when the information would be of great practical value.

The time must be fairly near when emergency landing grounds will not be required, but I think that for two years more the Air Ministry should maintain two landing grounds

between Croydon and Lympne, and they should insist upon the French providing one near Abbeville and another near Beauvais.

Airplane and Engine Design

I will now turn to the subject of airplanes and engines and the first remark I will make is that manufacturers must guarantee their productions for a reasonable period after delivery, the guarantee must include the risk of parts having to be re-designed owing to faulty design in the first place. It is no use a manufacturer selling a batch of engines and after three months admitting that the compression is too high and offering to supply new sets of pistons for £60 or £100 per set; and then after another three months admitting that the connecting rods are of unsuitable design and refusing

Handley-Page W.8 passenger transport airplane (two 450 hp. Napier "Lion" engines). Accommodation 14 passengers

to replace them except at the cost of over £200. I can only say that those manufacturers who are not prepared to guarantee their goods for the purpose for which they were purchased will be left without orders as soon as opportunity occurs. I am glad to say that there are signs of some manufacturers of machines taking some of the responsibility for their design.

In the interests of aircraft manufacturers I should like to sound a modest note of warning to the effect that they should not let history repeat itself by forcing the air transport companies into manufacturing their own machines, due to high prices, as has been the case with other forms of passenger transport. They must bear in mind that it is difficult for a manufacturer to retaliate, since he must make his machines suitable for as many markets as possible and therefore cannot specialize.

To my mind the price of the present day machine is altogether too high, although efforts seem to have been made to reduce the price. With the present wood construction, which still presents outstanding advantages, I am sure a lot more can be done. The all-metal machine seems as far off as ever and I doubt very much whether it will ever be nearer than a composite of metal and wood.

Notwithstanding the many times I have expressed my candid views on such questions as engine installation, cowling, controls, etc., I find very little improvement today in most of the latest designs of airplanes, and the war-type practice in many cases appears to be very deep rooted.

Detail Design

Also there still appears to be a strong tendency in design to put appearance, in the way of pleasing exterior lines, before utility and service. In the design of the various metal clips and fittings on our airplane I plead for the use of ordinary commercial mild steel plate, which after working requires only the crudest annealing. In speaking of the propeller, I think that it is time a weather-proof propeller was in transport service. A metal propeller fills the bill if it does not weigh too much or absorb too much power, but I think we are on the wrong lines still trying to use a metal tip onto a wood propeller, which twists and stretches all the time it is working.

The continued use of the pneumatic tire surprises me. I feel sure that a solid-tired wheel can be designed which will transmit safely all the shocks and forces to the undercarriage damping gear, and yet not be too heavy. The Germans used wooden tires during the latter part of the war. My critics will now tell me that they soon changed to pneumatics whenever they could get them. This is true, but one must bear in mind that the German undercarriages are not as shock-absorbing as ours, and the fact remains that the German wheels stood up very well.

On the subject of engines, my chief complaint is the cost of the engine and spare parts. I give a few examples and comparisons. One of the best known modern airplane engines costs £6,000 per ton. Complete machinery, including boilers and all auxiliaries, for a 35-knot destroyer costs only £200 per ton. Complete machinery, including boilers and all auxiliaries, for a 25-knot cross-channel vessel costs about £90 per ton. I am told that the reason for the high cost of the airplane engine is due to the expensive material and the still more expensive testing and heat treatment. If this is a fact then we must sacrifice 20 per cent of the engine weight and get down to an article which will appeal to the commercial engineer, an engine which will run 30,000 miles without overhaul, and I am sure that one giving such results could soon be evolved if the type tests for these engines were made on the time table basis. I suggest that three 3-hr. stretches a day with one hour's interval between, during which time the engine must not be touched, the engine to start at the same hours every day until 300 hr. is reached, ten minutes being allowed before the time table time for starting and warming up to full power. The three-hour stretches should comprise 10 min. at the start at full power, then 75 per cent full power for the remaining 2 hr. 50 min. The engine that can stand up to this test, even if its price is not lower than say 25 per cent below present prices, will fill the bill.

—*Paper read before the Royal Aeronautical Society*

Bids for Naval Spotters

The Bureau of Aeronautics of the Navy has just asked American airplane manufacturers for bids on a small number of a new spotting seaplane, designed by the construction division of the Naval Bureau of Aeronautics, the details of which are not revealed. These planes are to be used for spotting the fire of the guns of the fleet, and it is believed they will be small fast craft carrying two or three men. Detailed plans of the new seaplanes have been submitted to airplane manufacturers, so that they can make definite bids for three each, though the total number to be ordered was not announced.

Soaring Flight and Soaring Aircraft

A Review of the Progress Achieved in Soaring Flight with Considerations of its Practical Possibilities

(Concluded from last issue)

Particularly interesting were the gliders entered by Senator Zeise of Hamburg. One of these was equipped with auxiliary power in the form of two small flapping wings which the pilot could actuate through pedals, the idea being to use the flapping stroke when the energy of the wind would be insufficient to support the machine in normal soaring flight. The other Zeise glider was fitted with movable wing tips which the pilot could set at different positions with respect to the wings, varying not only their inclination to the horizontal (incidence), but also their position in relation to the fuselage.

Most of the gliders were fitted with skids so they could slide along on the ground without difficulty, and so take off in a fair wind. With a strong wind blowing four men would grab the wings and push the machine forward into the wind until it would derive support in the air. The take-off in this manner would occur within a short distance, generally a few yards. If the wind was insufficient for lifting the machine when launched in this manner, a sort of catapult was used, whereby the glider would be projected into the air. This device consisted of a rope in which sections of rubber strand were incorporated, and which was passed around the rear end of the skids. When a glider was to be launched, a number of men held on to it, while another squad put the rope in tension. On a sign of the pilot the men at the wings let go, whereupon the machine would be shot into the air, and the rope would automatically detach itself from the skids. In some cases wooden runways treated with soap were employed to make the take-off smoother.

The Great Flight of Harth

Remarkable as the flights made during the Rhön meeting were, they were exceeded shortly afterwards by a performance which made the art of soaring flight jump ahead, rather than advance. As was said above, the Grand Prize of the second Rhön meet required a minimum mean falling speed of 33 ft per minute whereas the best performance (Koller and Klemperer) was far in excess of this figure, being 80 ft per minute. However, on Sept 13 last Herr Harth, a soaring experimenter who had not participated in the two Rhön meetings, although his investigations date back some ten years, made a flight of 21 min 35 sec with a loss in height of only 40 ft. This works out at a mean falling speed of slightly *less than 2 ft per minute*, or 2½ *in per second*. This ratio, and the fact that Harth's flight was not made in one general direction as was the case with the long cross-country flights of Klemperer and Martens, but took the shape of a circling flight in the course of which the pilot flew with and against the wind over fairly even ground, seem to indicate that Harth actually did soar, although he may not have soared all the time.

The following interesting particulars of this great flight are taken from a statement given out by Harth's associate, W Messerschmitt, to the *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, from which it is translated

"On the day of the flight, Sept. 13, the wind was blowing in strong gusts with frequent changes in direction at an average speed of 22 m p h, which would however at times suddenly increase with hurricane force to twice that strength. Heidelstein Hill, from which the start was made, reaches 2725 ft above sea level, but the slope of the hill to windward is only from 2 to 3 deg above the horizon, followed by slightly steeper slopes (4 to 6 deg), which in their turn end in a flat plain extending for several miles, after which there occurs again a very flat slope.

"Harth first made a few flights up to six minutes' duration without any loss in altitude, and as the wind strengthened he decided to attempt a much longer flight, and reach, if possible, greater heights than before. At the same time he saw the possibility of letting the machine rise into the air without outside assistance, merely by utilizing the strong gusts. This he succeeded in doing, and once off the ground he began climbing into the wind until he reached a height of 200 ft. He then made a left turn and flew with the wind back over his starting point, whence he flew a circular course all around the hill top, then out over the lowlands. After a while he turned about and flew back over the hill, and describing two half turns in opposite directions he landed 40 ft. below, and about 500 ft from his starting point

"As the flight was made over practically level country, Harth is of the opinion that ascending air currents had nothing to do with it, and that he actually soared with the help of the irregularities in the wind. He noticed that the speed of his machine varied considerably when he was flying it against the wind, and that it always rose on turns, while it did not seem to lose any heights when flying with the wind. He also states that the machine remained perfectly steady in the midst of the gusts, and he attributes this fact to the use of movable wing tips which are made to bend automatically into the wind (*anpassungsfähige Tragflächen*) and so keep the machine on its flight path.

"The object of our experiments, motorless flight of sufficient duration seems now to have been attained. The results obtained prove that there exists at present a type of soaring machine which can easily be flown for any length of time in the most usual weather without requiring from the pilot any physical effort."

The Harth Messerschmitt Soarer

The type of soaring aircraft developed by Harth and Messerschmitt is the outcome of extended experimentation which began in 1910. Their first flights took place in 1914, in winds of about 43 m p h. While the war put a temporary halt to their work, this was resumed after the signing of peace. A number of soaring aircraft were constructed by the two associates, varying in area from 97 to 316 sq. ft, in span from 23 to 39 ft, and in dead weight from 88 to 123 lb.

During 1920 seventy-five flights were made by Harth. The best results were obtained in a wind of 25 f p s. over ground having a slope of from 2 to 4 deg, a maximum distance of 700 ft. being covered in 67 sec with a loss in height of 25 ft.

The machine in which Harth made his 21-min. flight is a "high-wing" monoplane which is somewhat reminiscent of the Munchen glider described above. The wings are rectilinear in elevation and have a form in plan similar to that of the early Etrich monoplanes, and are fairly well cambered. The body consists of a triangular lattice work to the rear of which the tail surfaces are attached. The pilot is seated below the leading edge of the wings, and controls the machine by means of two levers.

It is interesting to note that, as the result of the tests made in 1920, dealing more particularly with changes in direction when soaring, the rudder which was originally fitted to the Harth machine has now been done away with, the balancing wing tips being deemed sufficient for insuring all maneuvers. No details are on hand regarding the plane of rotation of the wing tips. The characteristics of the latest Harth soarer are given in Table I, from which it may be seen with reference to the data given above that the 1921 model is a smaller and lighter machine than the largest built so far.

The Nimführ Soarer

This review of the most successful soaring aircraft in existence would be incomplete without a mention of the Nimführ machine, which has given rise to considerable discussion

in foreign aeronautical publications. The plans of this machine, which is yet to be built, provide for wings so constructed as to automatically adjust themselves to the "secondary fluctuations" in the wind, mentioned before, and so extract from the wind the energy which the birds are believed to utilize for soaring flight

This object the Nimführ soarer seeks to attain by the use of wings the undersurface of which are designed to assume the periodical vibrations of the wind With this end in view the wings, which are rigidly attached to the body, are covered on the upper surface with sheet *elektron* (a new aluminum alloy), while the under surface is covered with balloon fabric The latter is given variable tautness by means of a turbo blower which the pilot actuates through pedals

The machine is to be fitted with an engine driving a propeller, but the power plant is to be used only in the absence of suitable winds. In addition a small servo-motor is to govern the controls automatically, its action being determined by a "*wind feeler*" which is designed automatically to indicate the slightest changes in direction and force of the wind. The servo-motor also effects the required changes in the area, angle of incidence and section of the wings Another instrument, called *accelerometer*, is connected with the servo-motor, and thus controls through changes in incidence the altitude

It will be seen from these particulars that the Nimführ soarer represents an ambitious attempt toward a perfected soaring aircraft Whether the time is ripe for such radical innovations, considering that artificial soaring is still in its infancy, remains to be seen

"Auxiliary" Soaring Aircraft

In the meantime the German soaring experimenters are seriously considering the possibility of building soaring aircraft fitted with small auxiliary power plants. Basing themselves on the experience gained in the soaring trials of the last two years, they are of the opinion that it would be possible to build a single-seater soarer having 160 sq ft wing area, and a 5—8 hp engine for a gross weight of 330 lb Such a machine would only require a landing run of 10 ft For a two-seater soarer there would be required a wing area of 270 sq ft and an engine of 12—18 hp, with a gross weight not exceeding 550 lb These characteristics are based on the Aachen type of construction.

Such a development of the soaring machine into an "auxiliary soarer"—to adapt a well known seafaring term—would have several advantages. While the sporting and experimental value of the pure soarer is not questioned, it should be realized that as long as such machines are not fitted with a power plant they are merely interesting from the viewpoint of sport and experimentation To our view, however, soaring aircraft have much greater possibilities, provided they be fitted with an auxiliary engine, for it is this development which will eventually lead to the low-priced popular airplane In the meantime it would seem that the best means for attaining this object is to experiment first with motorless gliders and soarers, so pilots may become familiar with the peculiar kind of pilotage required in motorless flights As their skill improves, and perfected soarers become available, the proposition of fitting these machines with small engines can be entertained To start from the "minimum airplane" with the endeavor of turning it into a good soarer would seem conducive to less certain results than the German system of improving the glider first and fitting it with motive power afterward

Characteristics of the Principal German Soaring Machines

		Span	Length	Area sq. ft.	Wt. empty lb	Type
1	Harth (1921)	33' —"		185	109	M
2	Hannover	41' 6"	14' 9"	172		M
3	Muenchen	36' 4"	13' 3"	182	[illegible]	M
4	Aachen (1921)	32' 8"	18' 9"	182	145	M
	(1920)	31' 4"	19' 9"	172	117	M
5	Nuernberg	19' 6"	11' 10"	173	38.5	B
6	Gotha	23' 5"	17' 1"	137	130	M
7	Drude	30' —"	15' 2"	163	119	M
8	Stuttgart	31' 4"	16' 0" *	140	132	M
9	Weltensegler	32' 8"	18' 6"	194	82	M

PILOTS.

(1) Harth (2) Karl Koller (3) Arthur Martens (4) W Klemperer (5) Pelzner (6) Hasselein (7) Drude (8) Brenner and Schrenk (9) Lemach

Note—Lilienthal's gliders varied between 108 and 218 sq ft in area and between 33 and 55 lb in net weight.

Pantala's "flying bicycle" or *aviette* with which on July 9 1921 he flew a distance of 38 ft. twice in succession in opposite directions was a biplane of 20 ft. upper and 13 ft 4 in lower span 4 ft. chord 4 ft gap, and 130 sq ft. area The net weight was 87.4 lb and the maximum speed attained was estimated at 23 m.p.h. The incidence of the wings could be changed by the pilot by means of Bowden wires, up to 8 deg

Aerodynamic Characteristics of Aerofoils -- II

N.A.C.A. Report No 124

This collection of data on aerofoils has been made from the published reports of a number of the leading aerodynamic laboratories of this country and Europe The information which was originally expressed according to the different customs of the several laboratories is here presented in a uniform series of charts and tables suitable for the use of designers and for purposes of general reference

It is a well known fact that the results obtained in different laboratories, because of their individual methods of testing, are not strictly comparable even if proper scale corrections for size of model and speed of test are supplied. It is, therefore, unwise to compare too closely the coefficients of two wing sections tested in different laboratories. Tests of different wing sections from the same source, however, may be relied on to give true relative values

The absolute system of coefficients has been used, since it is thought by the National Advisory Committee for Aeronautics that this system is the one most suited for international use and yet is one for which a desired transformation can be easily made For this purpose a set of transformation constants is included in this report

Each aerofoil section is given a reference number, and the test data are presented in the form of curves from which the coefficients can be read with sufficient accuracy for design purposes. The dimensions of the profile of each section are given at various stations along the chord in per cent of the chord, using as datum the line shown on the curves. The shape of the section is also shown in reasonable accuracy to enable one to more clearly visualize the section under consideration, together with its characteristics.

Applications of Modern Hydrodynamics to Aeronautics

N.A C A. Report No. 116

By L. Prandtl

This report gives rather briefly in Part I an introduction to hydrodynamics which is designed to give those who have not yet been actively concerned with this science such a grasp of the theoretical underlying principles that they can follow the subsequent developments In Part II there follows a separate discussion of the different questions to be considered, in which the theory of aerofoils claims the greatest portion of the space The last part is devoted to the application of the aerofoil theory to screw propellers.

Calculations Stresses in Non-Rigid Airships

N.A.C.A. Report No. 115

By C P Burgess

No simple but comprehensive method of calculating the principal stresses in the envelope of a non-rigid airship has hitherto been described and published in the English language. The present report describes the theory of the calculations and the methods which are in use in the Bureau of Aeronautics, United States Navy The principal stresses are due to the gas pressure and the unequal distribution of weight and buoyancy, and the concentrated loads from the car suspension cables

The second part of the report deals with the variations of tensions in the car suspension cables of any type of airship, with special reference to the rigid type, due to the propeller thrust or the inclination of the airship longitudinally

Langley Field Wind Tunnel Motor Regulator

N.A.C.A. Develops Motor Regulator which Practically Solves Problem of Constant Propeller Speed in Wind Tunnel

By D. L. Bacon

The accuracy of physical measurements and the time consumed in making them depend very largely on the magnitude of any fluctuation which may take place with respect to time in the quantity to be measured If two or three observations of related quantities are to be made simultaneously, the time lag of the measuring devices and of the observers may be sufficient to introduce serious errors. If these fluctuations are of sufficiently short and regular period the mean value of the desired quantity may be estimated very closely by a skilled observer If, on the other hand, the fluctuations are very irregular, varying both in period and intensity, accurate reading is impossible and much time is consumed in taking even approximate measurements.

Wind tunnel experiments often involve the measurement of three or four variables in addition to the air speed and as these are likely to be either square or cube functions of the speed any large variation or uncertainty in the latter must be fatal to the efficient operation of the tunnel.

The main disturbances of air speed in a wind tunnel may be due to—

1. Changes in speed of the propeller shaft traceable to the source of power.
2. Turbulent and erratic air flow, including particularly the formation and breaking of eddies in the returning stream of air
3. Changed resistance of the tunnel to the passage of air because of changed attitude of the model being tested, requiring change in propeller r p m for same air speed

The first of these must undoubtedly be corrected before the others can be successfully dealt with.

Temporary Power Plant

During the first year of operation of the National Advisory Committee's wind tunnel, the only available sources of electric power were a pair of 25 Kw gasoline electric searchlight generators equipped with centrifugal governors and a 200-300 hp dynamometer driven by a twelve cylinder Liberty engine These supplied current at 250 volts to the wind tunnel drive motor, rated at 300 hp for one hour, with a base speed of 250 r p m at full field strength; by weakening the field the speed could be raised to a maximum of 1400 r p m Control was obtained through contactors and armature and field rheostats manipulated from the experimental chamber

A Veeder liquid tachometer driven from the propeller shaft served to indicate variations as small as one revolution in 1000 It was thus possible to compare the relative steadiness of two sources of power with considerable exactness and without having to rely merely on the judgment of observers Preliminary experiments showed that electrical measurements of the supply current and voltage were useless as a means of comparing the steadiness of motor speed.

Original Speed Variations

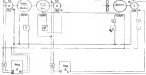
The characteristics of the temporary power plant units may be given as follows. The 25 kw generators when operated singly had a tendency to hunt, apparently due to faults manifolding and to insufficiently rapid governor action Although they could hold a nearly constant voltage when carrying a resistance load they were incapable of carrying the wind tunnel motor for a period greater than 30 seconds without its changing by at least 1 per cent in speed while changes of 5 per cent were frequent and 10 per cent were not unusual With both machines in parallel the fluctuations occurred more frequently but their magnitude remained approximately the same as with a single generator

The Liberty engine, having no governor, was controlled by a mechanic who set the throttle to hold approximately constant voltage for changes in load. He made no attempt to follow slight changes in voltage while the tunnel was operating at a supposedly constant speed When delivering 180 hp or over and with everything in first-class condition this power was occasionally very good, holding the wind tunnel shaft speed constant within 0 5 per cent for considerable periods and somewhat closer than this for a few seconds. It had the serious disadvantage however of seldom coming back to its original speed after a fluctuation but of settling down to some new speed instead This made it essential to keep a man constantly at the control rheostat prepared to correct the speed after each excursion If any of the spark plugs fouled through long idling which was frequently the case, the propeller speed usually became so erratic that the engine had to be shut down and the plugs cleaned before continuing the tests.

The Elimination of Variations in Shaft Speed

The new power installation* uses a 200 kw. synchronous motor generator which is supplied from the local power-house four miles away by a three-phase 60-cycle 3450 volt line on which this motor generator set is the greatest load.

The control system is rather complicated in its detail wiring diagram but the accompanying schematic diagram will serve



Wind tunnel power regulating equipment used at Langley Field

to illustrate the principles of operation The synchronous motor generator set is shown with two direct connected exciters A and B, while the exciter C is direct connected to the propeller motor shaft

Assume the set to be running Then exciter A, whose voltage is maintained constant by the regulator A, is seen to be furnishing constant excitation to the synchronous motor, the wind tunnel motor and the pilot generator C This pilot generator by acting upon the solenoid of regulator B, governs the voltage of the exciter B and hence the field strength of the D. C generator, the D. C line voltage, and consequently the speed of the wind tunnel motor

More explicitly the voltage across the terminals of pilot generator C is proportional to the speed of the wind tunnel propeller shaft If for any reason the r p m of the propeller and motor drop off the voltage of C likewise decreases and actuates the regulator B to increase the field on exciter B and thus raise the voltage of the main generator which tends to restore the speed of the propeller to the original value.

* This apparatus was designed and furnished by the Westinghouse Electric & Manufacturing Co. East Pittsburgh Pa.

The system is thus in a very stable state of equilibrium To set the motor for any given speed the field of exciter C is adjusted to suit by means of the two rheostats shown in its field circuit

The regulator armatures are adjusted to vibrate, normally, about five times per second, which means that the speed correcting impulses occur with the same frequency It is obvious that no disturbing influence can act for an appreciable length of time without engendering its own remedy The apparatus as now adjusted suffices to hold the propeller speed constant to within plus or minus two revolutions per minute when running at 1000 r p m. and somewhat closer at lower speeds.

The problem of obtaining practically constant propeller speed having been solved, there still remain the two other disturbing factors of erratic air flow and interference of the model with the air velocity The methods used to eliminate these disturbances will be outlined in another note.

—*N.A C.A. Technical Note No 81*

Notices to Aviators

Issued by Hydrographic Office, U. S. Navy

Colorado

Englewood—Landing field.—An emergency landing field has been established at Englewood, Colo , 4 miles south of Denver, the field is owned by J M Haldeman

The field contains 80 acres with long axis north south

The land is rolling, well drained and free from trees.

A wire fence incloses the north, east and south sides, telephone wire along the road on the north and east sides.

The altitude of Englewood is 500 ft

Prevailing wind, southwest

Gas and oil may be procured either from Denver or Littleton, both four miles distant (N A 12, 1921)

Florida

Facilities for the operation of seaplanes—The following information concerning facilities for the operation of seaplanes at the below-mentioned ports has been received from the Commandant of the U. S Naval Air Station, Pensacola, Florida, under date of Nov 2, 1921

St Petersburg—Latitude 27° 46' N., longitude 82° 38' W

Anchorage —There is ample water for anchorage of seaplanes ranging in depth from 1 ft up to 20 ft Holding ground is good; beach not suitable for beaching planes. There is a sheltered inner harbor in the southern part of the town, but the channel leading to it is somewhat narrow for large seaplanes to maneuver under unfavorable conditions

Supplies —Gasoline and oil may be obtained from a wharf in the inner harbor from hose lines, also from the wharf in the outer harbor from tank wagons. There are two private seaplane hangars at St Petersburg from which minor spare parts and repairs could probably be obtained

Communication —Telegraph station and Navy radio station

Miami.—Latitude 25° 46' N , longitude 80° 11' W

Anchorage —Good anchorage in depths from 1 ft to 10 ft A sheltered anchorage can be obtained in the Miami River Several very shoal spots exist which must be avoided in taking off and landing

Supplies —Seaplanes may obtain gasoline and oil from a gasoline dock in the Miami River The river is quite narrow and somewhat difficult to navigate by large planes in unfavorable winds Several civilian aviators operate planes at Miami, and it is probable that minor parts and repairs could be obtained from them

Communications —Telegraph and Navy radio stations

Titusville—Latitude 28° 36' N , longitude 80° 49' W

Anchorage —Shore is unsuitable for beaching planes. Holding ground is good There is no inner harbor in case of heavy weather, but a lee can be obtained for winds from any direction

Supplies —Gasoline and oil may be obtained from the gas filling station conspicuously located at the end of a dock The wharf is easily approached from all directions. No aviation supplies are available

Communication —Telegraph office open only during the day

St Augustine—Latitude 29° 54' N , longitude 81° 11' W

Anchorage —Beach is unsuitable for docking Good anchorage exists in sheltered waters with good holding ground

Supplies —Gasoline and oil may be obtained from boats. So far as is known no aviation supplies are obtainable.

Communication —Telegraph.

Fernandina—Latitude 30° 40' N., longitude 81° 28' W.

Anchorage —No suitable beach for docking planes Available anchorage space has a depth of 30 to 60 ft. Ample room for taking off in all directions may be had by taxiing a short distance

Supplies —There are two gas-filling docks from which gasoline and oil may be obtained The directions of approach to the docks is limited and might cause embarrassment in unfavorable weather No aviation supplies are available

Communication —Telegraph, not open after 6 p. m (N A 12, 1921)

Seaplane route from Atlantic to Gulf ports.—To shorten the trip by seaplane from Atlantic ports to Gulf ports and vice versa the following route across Florida has been used and found practicable From Jacksonville, Fla , up the St. Johns River to the head of Lake George, thence on a southwesterly course over Lake Kerr, Lake Bryant, Lake Weir, to Paunsoffkee Lake, thence on a westerly course across Tsala Apopka Lake; and thence to Crystal Bay, just north of St Martins Keys. The total distance overland, from Jacksonville to St. Martins Keys is about 130 nautical miles, with a maximum distance between landing places of 13 miles. Landings could be made on all the lakes in this chain, but some difficulty might be encountered in taking off large boats from the smaller ones. (N A 12, 1921)

Vermont

Burlington—Lake Champlain—Landing for seaplanes—The commanding officer, United States Naval Air Station, Rockaway Beach, Long Island, reports that a landing for seaplanes can be found at Burlington, Vt , on Lake Champlain, in any depth of water from 0 to 40 fathoms, sand bottom, with excellent beaching facilities.

Obstructions consist of breakwater, small boats and a few fish stakes placed wide apart.

Landmarks —Breakwater and lighthouse

Supplies —Gasoline, oil and fresh water, but no plane supplies, garages.

Note —Burlington is a good place to go with either land or seaplanes; altitude should be about 4000 ft Follow the Hudson to Glens Falls, then jump over to Lake George; do not follow the canal There is good water all the way except small stretches of the Hudson above Albany and 15 or 20 miles of land between Glens Falls and Lake George (N. A. 10, 1921)

Virginia

Yorktown—Aviation activities discontinued.—The following information has been received from the Chief of the Bureau of Aeronautics, Navy Department

Aviation activities have been discontinued at Yorktown, Va. This field will now be available only as an emergency landing field

Gasoline, spare parts, etc , will not be available.

(See Notice to Aviators 7 of 1921) N. A 11, 1921)

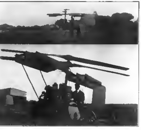
Some Notes on the Helicopter

Elements of the Problem — Some Experimental Results — Difficulties yet Awaiting Solution

By M. B. Sellers

Helicopter, Screw Wing.—A flying machine, depending for its lift on a vertical screw or propeller. Next to the flapping wing machine the oldest attempt to solve the problem of flight. References to some of the more recent machines will be found at the end of this article. Among these Cornu got a lift of 723 lb. or 44 lb. per hp., and very recently a captive helicopter, the "Petroczy," lifted four men and rose to a maximum height of 50 m.

The helicopter should be able to rise and descend vertically (or with small horizontal motion), should lift a reasonable amount (say 15 lb.) per hp. and travel horizontally 30 or more m.p.h., descend safely with engine dead and be controlled with engine on or off.



The Berliner helicopter (1920) off and on the ground

The *lifting propeller* is in a general way similar to the air plane propeller, which has received considerable study. For slow ascent we should want a propeller giving a maximum static thrust per unit torque, and this has led some inventors to give the blade a constant inclination from root to tip, instead of a helical pitch. It must, however, be remembered that the propeller produces and operates in a current of air, the inflowing stream tending toward a uniform velocity throughout the swept area. It would seem, therefore, that a slightly radially expanding pitch would be best.

Pitch Ratio.—The pitch ratio (pitch over diameter) for a maximum static thrust for a given torque will, among other things, depend on the blade section adopted. For the propellers which I tested (Aug., 1917) it was between 0.25 and 0.5, probably near 0.33, while for the maximum thrust for a given horsepower and diameter it was near 0.5. Recent tests at the Leland Stanford University by Mr. Snyder gave approximately the same results.*

Blade Outline.—Segmental blades have been much used, but this form is not good. Theoretically, the most efficient part of blade is near the hub, on the other hand, the part near the hub contributes a small percentage of the total thrust, and in some cases the structure of the machine interferes with the action of this part of propeller.

A shape approximating a rectangle with rounded ends seems best.

Blade Section.—As in airplane propellers, a good wing section giving adequate thickness is best.

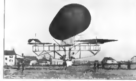
Number of Blades.—Some experiments with four-bladed model propellers which I made gave 83 per cent of the thrust of a two-bladed propeller for the same torque. For the same speed the thrust was 1.6 times that of a two-bladed propeller, requiring twice the horsepower.

Coaxial Propellers.—My experiments showed that, for the same torque the forward propeller pulls the same as when alone, but the rear one lost 25 per cent of its thrust. This was true for all distances apart tried. To prevent vibration, the distance apart should be at least 10 per cent of diameter.

The same results were obtained for four-bladed propellers. The speed of rotation was about the same for both propellers.

Double Decked Propellers.—The late Dr. Peter C. Hewitt suggested the possible advantage of superposing two propellers braced as in a biplane. Accordingly I tested two propellers thus arranged, but without bracing, and spaced at different distances apart. For a spacing equal to the chord, and for the same torque, the loss in lift was about 15 per cent and at reduced speed (about 74 per cent of speed).

A further test was made of two double decked propellers placed coaxially and rotated in opposite directions. The loss due to this arrangement was approximately 25 per cent for



The Oehmichen helicopter with its stabilizing balloon (1920)

the rear propeller, as in the former similar test. The two gave 1.75 times the thrust of one alone.

Resistance during Descent.—It has been suggested that we depend on the resistance of the propellers to retard descent, when the engine fails.

When the propeller is blocked, its resistance is only that due to its area. But when it is allowed to rotate, its resistance increases.

M. Riabouchinsky † found that, for a pitch ratio of 0.25 the resistance augments to 4½ times that when blocked. For higher pitch ratios the increase is less. Dr. Zahm tested some propellers for me in the Navy Wind Tunnel. The rotation of these propellers was produced by a 20 m.p.h. wind current, and the speed of rotation controlled by a brake. They were all 30 in. in diameter and 2¾ in. broad at tip. (1) The resistance increased with the number of revolutions p.m., till

* See Problem of Helicopter—N.A.C.A. Technical Note No. 4

† Bulletin de l'Institut Aerodynamique de Koutchino Vol. II

the maximum was reached at or near where the pitch speed equalled the wind speed. (2) The maximum resistance was greater for a low pitch, and for a greater camber. (3) For a two-bladed propeller of 10 in. pitch, the maximum was one-half the resistance of the disc area, and for a four-bladed propeller it was equal to that of the disc area.

It is evident that if propellers are large enough their resistance will be sufficient for safe descent. However, it would be necessary to uncouple them from the engine, and to avoid reversing the rotation, and also running blades backward, it would be advisable to provide feathering blades.

This brings us to the question of size of propellers required. The expression for thrust T, and horsepower HP, for propellers, identical except in size, are $T = A\,N^2D^4$ and $HP = B\,N^3D^5$, where N is revolutions and D is diameter, A and B coefficients determined by experiment. The thrust per hp. is

$$W = T/HP = a/b \times 1/ND \quad \ldots\ldots\ldots (1)$$
$$ND = a/bw, \text{ then } T = a^2/b^2 \times D^4/w^2 \quad \ldots\ldots\ldots (2)$$

That is, the thrust per hp. varies as tip speed of propellers.

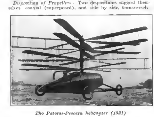
For a given tip speed the thrust varies as the square of the diameter. If we know by experiments the value of a^2/b^2, then equation (2) gives us the diameter required for a certain thrust per horsepower. Experiments show this value to be around 600 for a very good 2 b. propeller of 0.5 pitch ratio.

Horizontal Travel.—When a lifting propeller, rotating on a vertical axis, *advances* horizontally, its lift is augmented for the same speed of rotation, also its lift per horsepower is increased.

It is obvious that the *blade* which, during rotation is moving in the direction of advance, exerts more lift than the one which is moving backward.

To equalize the stress on the blades under these conditions one inventor, T. O. Perry, employs automatically feathering blades, the advancing blade being turned at a smaller angle of attack, and the receding blade at a larger angle. Thus the lift of the blades is equalized and also a propulsive force in the direction of advance is furnished. Mr. Perry also has means to manually change the incidence of the blades. These devices might add considerable weight to the machine.

Disposition of Propellers.—Two dispositions suggest themselves: coaxial (superposed), and side by side, transversely.



The Pateras-Pescara helicopter (1921)

Each arrangement has advantages, but coaxial propellers require less weight of structure, and appear to be safer.

It is necessary to have both coaxial propellers identical in pitch, or there will be a tendency to rotate the structure. One inventor employs a means to change the pitch of the lower propeller; thus, he can turn the machine to right or left as desired. This device adds practically no weight to the machine.

Horizontal Travel.—This may evidently be effected by inclining the lifting propellers, or by a separate driving propeller. The former seems more efficient, as considerable propulsion can be gained without much loss of lift.

Several inventors have attempted to produce a combination helicopter and airplane, but no attempt which I have examined is free from objectionable features. However, something good is possible along this line.

Much of what I have here said was embodied in my report on helicopters to the Naval Consulting Board in 1917, because nothing new has developed to make a change in those statements necessary. At present, it seems to me that the helicopter is chiefly a problem for the engineer, to so proportion and arrange the various elements to produce the most useful

The Petroczy-Karman helicopter (1918) hovering at 160 ft. height

machine, and to overcome the dangers and difficulties in its operation.

A high lift per horsepower can be had with large propellers, also, probably, enough parachute action in case of engine failure, but large propellers involve considerable weight, and a high horizontal speed seems more difficult to attain with them. With small propellers a higher horsepower and some form of parachute are required. I have not considered the matter of stability. Right at the start we find that there will be difficulty in getting off the ground in a wind, especially with large propellers. It is highly important that some kind of machine be got into the air in free flight.

The following is a partial list of the most noteworthy machines:

Godard.—(Sci. Amer. Dec. 9, 1905,) made some experiments with aerial screws. With a two-bladed propeller about 10 ft. diameter, with foot power he got 30 lb. thrust. With a 10 hp. motor and two superposed screws he got 220 lb. lift.

Dufaux.—(Sci. Amer. Oct. 21, 1905) Model 51 lb., 3 1/10 hp. engine, rose to roof of shed, two 4 bladed propellers. Model like Bréguet model. Diameter of propellers not given.

Léger.—(Aérophile, Aug., 1905) ½ size model—superposed two-bladed propellers. Diameter 6.24 m., width 1.75 m., weight each 21 kg. Machine alone 85 kg. Used electric motor 7½ hp.—6 hp. net, lifted 110 kg. at 40 r.p.m., and 12 to 15 hp. lifted 185 kg. at 60 turns.

Santos Dumont.—(Sci. Amer. Feb. 10, '06). Fig. 2. Two vertical propellers fore and aft, and one horizontal to drive

Characteristics of the Principal Successful Helicopters

Type	Engines No.	Hp.	Total rated hp	Propellers No.	Dia (m.)	R p m	Disc area (sq m.)	Weight empty (Kg.)	Total Lift (Kg.)	Power loading (Kg./h.p.)
Dufaux (1905)*	1	9	9	4	2 0		12 6	17 0	23 5	7 8
Leger (1906)	1	25	73	2	5 0		80 4	[illegible]	185 0	18 4
Bréguet (1907)†	1	45	45	4	8 0		201 0	520 0	800 0	20 0
Cornu (1908)	1	24	24	2	6 0		56 8	190 0	328 0	20 0 (at 16 hp.)
Berlin (1908)	1	190	150	2	[illegible]		12 0		910 0	
PKZ1 (1918)‡	1	190	190	4	11 8	800	49 0	920	1,100	5 8
PKZ2 (1919)‡	3	120	360	2	6 0	800	28 8	1400	1400	4 15
Crocker-Hewitt (1918)	1	100	120	2	10 0	109	178 0		1 153	9 2
Pescara (1920)	1	55	55	2	6 0	150	28 5	500	590	8 5
Oehmichen (1920)	1	25	25	2	8 0		64 0	360	333§	13 3
Berliner (1920)	1	80	80	2	[illegible]		52 75	280	400	5 0

* Two-bladed side model. Captive helicopter.
† First helicopter to leave the ground with the pilot aboard (Aug. 24 1907).
‡ The initials P K Z stand for Petroczy, Karman and Zurovec; the three men who were mainly instrumental in designing, building and testing these helicopters.
§ This figure includes 1 hr. fuel.
¶ The difference between the net weight of the machine and the total lift is made good by a cylindrical balloon of 144 cu m capacity which is however mainly used to maintain the stability in free flight tests.

machine Propeller diameter 20 ft, silk and bamboo, total weight, including operator, 352 lb 24 hp No trials recorded

Berlin—Lake Santos Dumont machine in principle—no trials recorded Sci Amer Supp Mar 14, '08, Afrophile No 7—'08.

Cornu—(Sci. Amer. Apr 18, '08 and Supp May 16, '08). Two lifting screws fore and aft horizontal motion by inclined planes in propeller blast. The propellers were two bladed 19 7 ft. diam., 9 8 ft. pitch, each blade silk on tubes— 3 x 6 ft, total area 64 sq. ft. Machine weighed 100 lb, engine 24 hp. 8 cyl Antoinette, transmission by leather belt which slipped throughout trials. The best lift was 723 lb = 44 lb. per hp and 9 lb. per sq. ft. At another time with 85 turns of propeller (motor 850 turns) it lifted 518 lb with 14 hp. estimated.

Bréguet—Helicoplane, (Aerophile, Apr 15, '09). Tandem biplane with two transversely disposed screws, inclined at angle of 40 deg. to lift and propel. Propellers four bladed D = 4 20 m. (N not given) 45 hp horizontal thrust 250 kg., vertical thrust 300 kg; weight 550 kg empty Rises after run of 20 m. (Have not investigated subsequent history of this machine.)

Berliner—(Am Aeronautics, Oct, 1908, model) (Sci Amer, 1908 large machine) Tubular concentric shafts, superposed propellers, 2 motors 36 hp each, 900 r p m propeller D = 18 ft 8 in, 80 sq ft, 120 r p m Total weight lifted 610 lb

Luyties—(Sci Amer, July 11, '08). Two four bladed propellers on vertical shaft—progress by inclination. Wide blades, cloth stretched flat on frame D = 25 ft Area 40 ft Rev = 31 Lift 700 lb Engine 20 hp Rev 1550 Machine weight 1000 lb, but too frail

Kimball—(Aeronautics, Sept., 1908) This machine had a large number of small lifting propellers on the theory that several small propellers are lighter than one large one of the same capacity However, transmission troubles have to be considered Machine was destroyed by fire Do not know what results were obtained

Petroczy—Karman—Captive helicopter a three-armed-frame carrying three Le Rhone motors, producing 120 hp These drive two coaxial lifting propellers 6 m diameter, at 800 r p m A parachute, 250 sq m, takes care of descent when required Weight empty, 1300 kg, observed lift, 1800 kg Rose to 50 m altitude (with four men aboard). (See Technical Notes, No. 47, N A C A, Apr., 1921.)*

* For amplification of the above information the reader is referred to the description of the Jacobs, Bréguet, Petroczy Karman Zurovec, Pescara, and Oehmichen helicopters which appeared in AVIATION during the past year, and to the table of characteristics of the most successful helicopters built to date printed at the head of this page [illegible]

Fire Destroys Hangars and Planes

The Central Park, L I, hangars and machine shop of the J L Aircraft Corp. of New York, together with four JL6 monoplanes, were totally destroyed by fire on Feb 8 Two planes and the office building were saved through efforts of employes and the local fire department. The loss is partially covered by insurance.

The blaze originated from ignition of gasoline which dripped on a wooden floor from a blow torch in the hands of mechanic E Buell, who was using the torch in repairing a radiator Buell immediately secured a Pyrene extinguisher but was unable to check the blaze before it communicated to the walls and roof. Fanned by a high wind the original and adjoining buildings, except the office, all of wooden construction, were soon destroyed

John L Larsen, president of the J. L Aircraft Corp., stated that the buildings would be replaced with iron structures Loss of the services of the planes destroyed, while serious, would not be allowed to interfere with his recently announced plans for commercial air service, Mr Larsen said also

Contract for Martin Bomber

In last week's AVIATION it was stated that a contract for fifty Martin Bombers had been awarded to the Curtiss Aeroplane and Motor Co. It appears from later information that it was decided to change the plans and twenty five of the Martin Bombers are now reported to have been awarded to the Aeromarine Plane and Motor Co C F Redden, president of the company when asked for a statement said that there could be no further information given at this time regarding the contract.

Program of French Soaring Meet

The preliminary program of the French gliding and soaring meet which will take place next August under the auspices of the Association Française Aérienne of Paris was recently agreed upon by the latter body.

Prizes will be awarded for the following performances

(1) Maximum duration in single flight, minimum of 5 mn.;
(2) Totalization of single flights, each to be of at least 30 sec duration;
(3) Landing contest to mark;
(4) Maximum height reached above level of starting point;
(5) Maximum distance in single flight. Minimum 2 km. (1¼ miles)
(6) Minimum rate of descent;
(7) Time elapsed over closed circuit.

The performances relative to maximum duration, maximum height above starting point, and maximum distance are to be recorded by means of barographs carried on board the competing aircraft.

"Who's Who in American Aeronautics"

The biographical sketches of men who are prominent in American Aeronautics are printed periodically in AVIATION. The first series will be shortly published in a more durable form, and revised issues will be published semi-annually to take care of the frequent changes in station of Army and Navy officers, and such other changes as may occur As errors and omissions are liable to occur in a compilation of this character, interested parties are requested to notify "Who's Who" Editor of the necessary corrections so the record may be kept up to date

Elisha Noel Fales

FALES ELISHA NOEL, Aeronautical Engineer born Lake Forest Ill 1887 son of David Fales and Mary Eaga (Lawton) Fales, married Frances Meigs Jan 4 1914

Educated Lake Forest Academy Armour Institute A B 1908 Harvard University S B 1911 Mass Inst. of Tech

Professional 1911 1912 Stone & Webster Engineering Corp 1910, Ironwood & Bessemer Railway & Light Co. 1914, Chicago Department of Public Service.

Aeronautical Activities Wind tunnel and gliding work Mass. Inst. of Tech 1909 1911 Assistant to Production Engineer Curtiss Aeroplane & Motor Co 1916 established course in aeronautics University of Illinois 1917 on Major Bingham's Commission to Toronto 1917, for development of cadet course wind tunnel expert U S Army 1917 to date

Books Learning to Fly in the U S Army 1917

Present Occupation: Aeronautical Engineer

Address McCook Field Dayton Ohio home 333 Westminster Ave Lake Forest Ill

William P. Sullivan

SULLIVAN WILLIAM P Commercial Aviation born San Francisco Calif March 20 1891 son of William Sullivan and Mary C (Manion) Sullivan

Educated Public schools Humbolt, St Peters and Technical (Mechanical and Aeronautical Engineering) all of San Francisco

Professional Pattern maker engineering and designing Pacific Gear & Tool Works, Pacific Fdry Co of San Francisco Airliner Engineering Corp New York City

Aeronautical Activities Experiments with gliders and models, airplane design and construction 1908 1912 supervising instructor of construction and repair U S. Naval Air Station Pensacola Fla 1917 1918 compiled U S Naval Aviation Mechanics Text Books Columbia University 1919 and officer in charge of completion of same at U S. Naval Aviation Mechanics School Great Lakes Ill 1920 Assistant Aeronautical Designer Remington Burnelli Airliner New York 1920

Present Occupation Airliner Engineering Corp

Address Amityville New York Box 428 home 3524 22nd St San Francisco Calif

R. C. Marshall

MARSHALL R C Air Mail Pilot born Jewell Tex Feb 2 1893 son of Joe Marshall and Fannie Marshall married Kathryne Dyer July 17 1917

Educated Public schools of Gordon Tex

Professional Telegraph operator 1909 1914

Aeronautical Activities Exhibition pilot in South 1914 1916 Thomas Bros. Aircraft Co and Thomas Morse Airplane Corp. 1916 to 1919 from 1917 to 1919 as test pilot Aug 1920 commercial flying in New York Pennsylvania and Florida Sept 1920 to date Air Mail Pilot

Member Vice President and Treasurer Air Mail Pilots Association of America

Present Occupation Air Mail Pilot

Address Air Mail Field home 901 South 2nd Ave Maywood Ill

John Peters Canfield

CANFIELD JOHN PETERS Lumberman born Harveyville Kans. July 17 1889 son of Harry D Canfield and Llewellyn (Merrill) Canfield

Educated Public schools of Muskogee Okla one year U S Naval Academy

Professional Retail lumberman Manager Fort Gibson Lumber & Hardware Co., Fort Gibson Okla 1920

Aeronautical Activities Training at Austin Tex School of Military Aeronautics, 1917 1918 flying instruction at Kelly Field and Hazelhurst Field to May 1920

Flying Rating Reserve Military Aviator May 1918

Present Occupation: Lumberman

Address 1070 E Florence Ave Los Angeles Calif

Charles F. Kettering

KETTERING CHARLES F Engineer born Loudonville Ashland County Ohio Aug 29 1876 son of Jacob Kettering and Martha (Hunter) Kettering married Olive Williams Aug 1 1905

Educated Country District School Loudonville Ohio high school Wooster Ohio normal school and a graduate E E and M E of the Ohio State University 1904

Professional 1909 invented the starting lighting and ignition system known as the "Delco" manufactured by the Dayton Engineering Laboratories Co. of which he was an organizer and subsequently elected President which position he still holds 1916 perfected and marketed the house lighting plant and other products known as Delco Light manufactured by the Delco-Light Co. of which he is Vice President; Vice President of the Dayton Wright Airplane Co President of the General Motors Research Corp and recently elected Vice President and Director of the holding company the General Motors Corp.

Aeronautical Activities Inventor of the ignition equipment used on the Liberty Motor and has also contributed in many ways to the electrical and mechanical improvements in aeronautical work his daily flights in his personal airplane enable him to obtain valuable first hand knowledge of the problems involved in flying which could not be obtained otherwise

Member Society of Automotive Engineers American Society of Mechanical Engineers American Institute of Electrical Engineers Army and Navy Club

Present Occupation President, General Motors Research Corp

Address Dayton Ohio

William J Malone

MALONE WILLIAM J Lawyer born Bristol Conn Dec 26, 1878 son of Michael Malone and Catherine (McKernan) Malone married June 10 1910

Educated Public schools of Bristol Conn LL B 1900, M L 1901 Yale University

Professional Admitted to Connecticut Bar in 1901 Member Legislature 1907 1911 Assistant Attorney General Connecticut last three years Judge city of Bristol last fifteen years Corporation Counsel City of Bristol eight years up to year when resigned to enlist commissioned Major 2nd R O T C Plattsburg Nov 1917

Aeronautical Activities Member Aviation Examining Board, Washington Cadet Gerstner Field 1918 C O 143rd Aero Pursuit Squadron Lake Charles Commandant Cadets at Gerstner Field O I C Interior Instruction Gerstner Field C O 352nd Aero Squadron Roosevelt Field Dec 1918 discharged as Major Air Service March 1919

Flying Rating Reserve Military Aviator May 1918 Junior Military Aviator Oct 1918

Present Occupation Aviation Commissioner of Connecticut since April 1919 Lawyer

Address First National Bank Bldg home 91 Bellevue Ave Bristol Conn

John Harlin Geisse

GEISSE JOHN HARLIN Exp Engineer born Fond du Lac Wis. July 17 1892 son of Charles F Geisse and Jennie (Harlin) Geisse married Esther Wallows Nov 8 1919

Educated Public schools of Fond du Lac B S in Mechanical Engineering 1917 University of Wisconsin Aeronautical Engineering Mass Inst of Tech

Professional Member State Board Engineers, 1916-1917 1919 1920 Assistant Chief Power Plant Section Engineering Division Air Service Sept. 1920 to date, Exp Eng Wright Aeronautical Corp.

Aeronautical Activities Aug 1917 Cadet Air Service training at Champaign Ill., Rantoul, Ill. Ellington Field

Flying Rating Reserve Military Aviator

Member American Society of Mechanical Engineers.

Present Occupation Exp Engineer Wright Aeronautical Corp.

Address 238 Lewis St; home 247 13th Ave Paterson, N J

Harry August Chandler

CHANDLER, HARRY AUGUST, Air Mail Pilot born Maplewood N J Dec 8 1893 son of Frank T Chandler and Augusta Chandler married Louise Fleming July 8, 1917

Educated: Public schools of Orange N J Newark Technical School Pennington

Professional Machinist, 1912, 1915 1919, electrical work

Aeronautical Activities: Aviation Mech at Hazelhurst Field, Aug 1916 student pilot, Hazelhurst, Aug 1917 Instructor Princeton Ground School lectures on Theory of Flight, Sept 1917 to April 1918 Asst Cross-Country Stage Commander Rich Field April 1918 to Oct 1918 student and Instructor Cazaux at Pursuit School Carlstrom Field Dec 1918 to June 1919 Air Mail Pilot Aug 1920 to date

Flying Rating Reserve Military Aviator Aug 1917

War Service Enlisted, June 1916 1st Lieut. Casual Officer at American Fields Hazelhurst Rich Dorr Carlstrom

Member Aero Club of America Air Mail Pilots of America.

Present Occupation Air Mail Pilot

Address Air Mail Service Cheyenne Wyo; home 269 Maple Place Mineola, N Y

Edwin Eugene Aldrin

ALDRIN EDWIN EUGENE 1st Lieut Air Service born Worcester Mass April 12 1896 son of Carl John Aldrin and Anna (Nelson) Aldrin

Educated Public schools A B 1915 Clark University Worcester Polytechnic Institute Graduate Student, 1915 Masters Degree (S M) 1917 Mass. Inst. of Tech

Aeronautical Activities Aeronautical Engineering M I T 1916 instructor wind tunnel work for N.A.C.A. 1917 Instructor Army and Navy School of Aeronautical Engineering at M I T 1918 Assistant Chief Airplane Section later Chief School Section Engineering Division, Air Service McCook Field 1919 to date

Flying Rating Airplane Pilot Sept 1919

War Service As above

Member Secretary Aeronautical Division American Society of Mechanical Engineers Society of Automotive Engineers.

Present Occupation 1st Lieut Air Service

Address c/o Air Officer U S Army Manila Philippine Islands home 95 Downing St. Worcester Mass

C. G Peterson

PETERSON C G Commercial Aviator born, Buffalo N Y Oct. 19, 1887 son of Charles Paterson and Jennie (Lapham) Paterson; married, Hildegrade Rogers Aug 7, 1919

Educated Public schools of New York City and Lockport, N Y Mech Eng 1909 Cornell University

Professional Engineering

Aeronautical Activities: Organizing and directing campaign for sale of surplus Navy aeronautical material Wright Aeronautical Corp. administrative sales and service

War Service: U S Navy Engineering duties, July 1917 to July 1920

Member Aeronautical Chamber of Commerce Cornell Club (New York), Toronto University Club Society of Automotive Engineers.

Present Occupation Assistant to President, Wright Aeronautical Corp

Address 269 Lewis St. Paterson N J home 920 West 123 St., New York City

Howard Sheaff

SHEAFF HOWARD Engineer born Beacon, N Y., April 24, 1899 son of Edmund H Sheaff and Alice C Sheaff

Educated Stuyvesant High School, New York City, Wesleyan University, Middletown, Conn

Professional Assistant to W H Barling with Wittemann Aircraft Co, 1920 to date

Member Aero Club of America

Present Occupation Wittemann Aircraft Co.

Address 1440 Broadway, New York City

New Air Surveying Device

Drawing correct contour maps by means of air photographs has hitherto presented considerable difficulties. It has always been theoretically possible, but the accurate measurement of the minute lengths on the plates necessary to determine elevations has been too difficult for practical application.

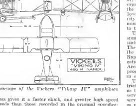
The Zeiss company has been supplying an instrument for drawing contour maps from stereophotographs, for several years. This instrument has recently been demonstrated in this country. The stereophotographs are taken with a special camera known as a photo-theodolite. Two sets of pictures are taken, one from each end of a carefully measured baseline.

The stereoautograph, which draws the map, consists of an arrangement to hold the plates and a system of linkage to transmit the motion of the plates to a pencil moving over a drawing board. There are three degrees of movement possible in the instrument and two for the pencil. The third movement is the elevation, and of course can not affect the pencil. To draw a contour, the instrument is set for the elevation desired and a pointer in the focal plane of the eyepieces is moved by means of the two controls corresponding to the horizontal axes, so that the point appears to be traveling over the surface of the ground, the point of the pencil, being moved by the same controls, draws the contour required.

This instrument is now being modified by the Zeiss company so that it will be able to interpret pairs of air photographs. This will require no change in principle but only a rearrangement of the controls. There are a multitude of very nice adjustments incorporated in the design. The instrument can be set for any base line and for any scale. It is possible to allow for differences in elevation of the two photographs of as much as 100 ft.

Viking IV for Naval Aviation

A Vickers "Viking IV" amphibian (450 hp. Napier "Lion" engine) ordered by U. S. Naval Aviation was recently tested at Brooklands, England, both by Captain Cockerell, test pilot for the Vickers firm, and Commander White, U. S. N. The machine is similar to the one described in the May 9, 1921, issue of AVIATION, except that it has a new high lift wing



Outline drawings of the Vickers "Viking IV" amphibian

section. This gives it a faster climb, and greater high speed and low speeds than those recorded in the original specifications which are reprinted below.

The Vicker "Viking IV" is a development of the "Viking III" which won the amphibian competition of the British Air Ministry in the summer of 1920, and from which it differs structurally chiefly on account of its being fitted with folding wings. The biplane wings have a large dihedral on the lower wings, and have no stagger or sweepback. The upper wings are in five sections, as may be seen in the accompanying outline drawings, while the lower wings are in four sections, there being no center section. The folding occurs from the second strut pair, the wings pivoting around the front spar. By folding the wings the span is reduced from 50 ft. to 33 ft. 10 in., whereby a considerable amount of stowage space is saved.

The hull is built of timber, planked with Consuta plywood, and fitted with two steps. The retractable landing gear is fitted slightly ahead of the wings. It consists of two telescope sprung struts, one at each side of the hull, and pivoted at the upper end, which carries the wheels at the other end. This gear can be swung forward and upward about the top pivot by a pinion working in a rack which forms a quadrant of a circle. The tail skid, for land work, is fitted at the rear step, and consists of an oleo-pneumatic operated steel shoe which also serves as a water rudder when the machine is afloat.

The accommodations of the "Viking IV" normally comprise five seats, two passengers being seated forward and one aft, with the pilot and mechanic occupying the central cockpit. By removing the passenger accommodation, a stowage space of 75 cu. ft. becomes available for mails and freight, or for military equipment, radio, etc.

A machine of this type is on order for the Japanese Naval Air Service, and another, fitted with a cabin, was recently delivered to the French Civil Air Department which intends to use it for experimental purposes.

The specifications of the Vickers "Viking IV," as originally issued, that is, before the high lift wing section was fitted to it, are as follows:

Specifications

Span	50 ft.
Overall length	33 ft. 6 in.
Maximum height	15 ft. 1 in.
Gap at center line	7 ft. 7 in.
Chord	6 ft. 6 in.
Total wing area	594 sq. ft.
Engine type and hp.	450 hp. Napier "Lion"
Weight empty	3728 lb.
Weight loaded	5800 lb.
High speed	110 m.p.h.
Climb to 6000 ft.	7 min. 20 sec.
High speed at 8000 ft.	114.5 m.p.h.
Absolute ceiling	13 250 ft.
Landing speed	[illegible] m.p.h.

Commercial Air Conference

An aviation conference of the states comprising the 7th Corp Area will be assembled in Sioux City, Iowa, on March 27, 28 and 29, for the purpose of completing city and district organizations in the entire corps area. This district includes the states of North and South Dakota, Minnesota, Nebraska, Iowa, Kansas, Missouri and Arkansas. Delegates from each city within these states will be in attendance as well as a large number of men nationally identified in aerial development, to take an active part in organization work.

The Seventh District Conference, the first of a series of similar meetings, is being sponsored by the national organization, of which the district organization will become a part. The conference is being called and will be conducted under the jurisdiction of John B. Coleman of Sioux City and Rufus Rand, Jr., of Minneapolis, representing the national organization, and E. R. Schultz, Chairman of the Seventh Corp Area Convention. In addition to organization work, the program includes plans to make the central west lead America in commercial aviation development.

The larger towns and cities in the states of the seventh district will be the first to take an active part in the organization, as the advantages to be had from aerial mail and transport services have been demonstrated by the Government Air Mail service and all enterprising cities are displaying great interest in plans for the extension of this method of transportation. A strong and representative delegation of business interests from each city of five thousand population or over is invited to join in the concerted efforts to be launched at the Sioux City conference, to bring aerial mail and transportation to the respective cities.

It was originally planned to hold the conference in January, but this was postponed to March in order to allow additional time for the formation of the organization of the national association in Washington.

Pay of Naval Flying Officers

Transmitting a draft of a proposed bill to equalize the pay of aviation officers of the Navy and Marine Corps with that of officers of the Army, Secretary Denby on Jan. 30, pointed out to the Speaker of the House that the Act of March 3, 1915, provided that no officer in the Navy senior in rank to Commander, nor any officer in the Marine Corps senior to a Major, should receive any increase in pay or allowances by reason of being lawfully detailed to duty involving actual flying in aircraft.

"This law," the Secretary explained, "is manifestly unfair, as it prohibits increased pay to officers of the Navy above the rank of Commander and to officers of the Marine Corps above the rank of Major, whereas all officers of the Army on duty requiring them to perform regularly and frequently aerial flights, receive increased pay." He further pointed out that the pay of Army, Navy and Marine officers had always been on a par, and that there seemed to be no reason why officers detailed to Naval Aviation should not receive the same increase for similar duty.

Calling attention to the fact that aviation is bound to expand both in industrial and military connections, he said that at the present time the flying personnel is composed mostly of younger men who, as they grow older, become of great value to this arm of the service, and explained that in order to keep the talent it is necessary to compensate them for the risks involved in actual flying. Without the increased pay it was shown there is no incentive to older men to remain with aviation, and they will become diverted to other lines of duty incurring less risk.

That there was still considerable risk in flying, was shown by the fact presented that from Jan. 1, 1919, to Nov., 1921, there were seventy accidental deaths of officers in the Navy, twenty-six of them having been performing line duty and forty four of them aviation duty. In the Marine Corps there have been a total of 18 accidental deaths of which 12 were on flying duty. The approximate percentage of deaths in the Navy is 0.0034, while in aviation it is 0.008, it was said. In the Marine corps the line death percentage is 0.005 and in aviation 0.20.

Secretary Denby called attention to the limit for subsistence set in the recent Budget Bill of $8 per day incident to flights in aircraft which, he said, was similar to that for Army officers, and asked that in justice to Naval officers on flying duty the proposed bill be enacted at an early date.

It is known in naval circles that when a major on flying status was recently promoted to Lieut. Colonel, without additional flying pay which was prevented by law, he suffered a loss of about $225 per month by his promotion, although he continued to fly.

Chrome-Molybdenum Steels

A very interesting paper was recently read by C. N. Dawe of the Studebaker Corp. of America before the Society of Automotive Engineers on "Chrome-Molybdenum-Steel Applications from the Consumer's Viewpoint." This paper gives a plain statement of facts regarding the application of chrome-molybdenum steels, more than 2000 tons of molybdenum steels of various compositions having been consumed in tests and the manufacture of all the important steel parts such as transmission and differential gears, rear axle shafts, transmission shafts, steering-knuckles, steering knuckle pins, and the like. The data of an extensive set of physical tests are given, comparing medium-carbon, chrome-molybdenum, chrome-vanadium, chrome-nickel and chrome steels, and the results are expressed by means of a merit index, taking into consideration yield-point, ultimate-strength, elongation and reduction of area.

The case-hardening grades of steel are discussed, difficulties that were encountered in the use of the low-carbon chrome-molybdenum steel in this connection being specified. The possibilities of nickel-molybdenum steel for case-hardening purposes are considered, the results so far indicating that it is a strong rival of low chrome-nickel steel, which is considered the best steel for commercial case-hardening at present.

Use of Canadian Air Board Stations

Notice to Airmen, No. 8 (1921)

The Canadian Air Board notifies the following:

In order to assist commercial aviation companies when undertaking long distance flights, Air Board Stations throughout the Dominion will hereafter be available as landing grounds for a commercial aircraft, and if required gasoline, oil and other stores will be supplied (on repayment) to enable the visiting machines to complete their proposed journeys.

The following are the storage, alighting and taking-off charges which in all cases must be paid before the departure of the visiting machines:

1. Stores at Ledger prices.
2. 10 per cent on the value of Stores to cover freight and handling charges.
3. Services of mechanics by the hour at cost accounting rates.
4. Landing charges, in accordance with the following table.
5. Storage in accordance with the following table.

LANDING AND STORAGE CHARGES	SMALL MACHINES	MEDIUM MACHINES	LARGE MACHINES
Alighting and taking off—			
By day	$0.50	$1.00	$2.00
By night	——	——	——
Open air storage			
Above 2 hr. up to 8 hr.	0.25	0.25	0.25
Above 8 hr. for each 24 hr., including the first 8 hr.	1.00	1.00	1.00
Per month	15.00	15.00	15.00
* Hangar Storage			
Unheated, per day			$0.15
Unheated per month			3.00
Heated (October to March incl.) pr. day			0.25
Heated, " " " " by month			5.00

* Hangar Storage per 100 sq. ft. or fraction thereof (to be ascertained by multiplying the greatest breadth by the over-all length).

Aerial View of Muscle Shoals

The Akers Airphoto Corp., with offices in the McCormick Building, Chicago, was recently organized for the purpose of making aerial photographs and aerial mosaic maps.

The new firm has just finished making a series of airplane photographs of the government property located at Muscle Shoals, near Florence, Ala. One of these photographs, which forms the cover illustration of this issue, gives a striking view of this property which has elicited so much comment in the last few months.

Coming Aeronautical Events

AMERICAN

Apr. 30 — *Spring Show and Opening Meet, Curtiss Field, Mineola, L. I.*

May — *National Balloon Race*

Sept. 6 (about) — *Detroit Aerial Water Derby, Detroit. (Curtiss Marine Flying Trophy Competition.)*

Sept. 15 (about) — *Detroit Aerial Derby, Detroit. (Pulitzer Trophy Race.)*

Sept. 30 — *First Annual Interservice Championship Meet. (In preparation.)*

FOREIGN

Aug. 1 (about) — *Coupe Jacques Schneider. (Seaplane speed race.) Italy, probably Naples.*

Aug. 6 — *Gordon Bennett Balloon Race, Geneva, Switzerland.*

Oct. 1 — *Coupe Henri Deutsch de la Meurthe. (Airplane speed race.) France. American elimination trials, if required, to be held about Aug. 15, at Mitchel Field, L. I.*

Naval Air News

Additional appropriations for the purchase of small tracts in connection with present naval air stations is sought by Secretary of the Navy Denhy of Congress, in order to clear np titles in several instances, and make it possible to dispose of certain lands held by the Navy during and since the War. Authority to purchase parcels of land adjacent to the air stations at Chatham, Mass., Lakewood, N. J., and Galveston, Tex., was sought in Secretary Denhy's letter to the Chairman of the House Appropriations Committee.

A 200 acre tract of land at Quantico, Va., is sought for Marine flying purposes and $20,000 is needed it was said; which wonld be an economical expenditure, there being no other land available in the vicinity.

* * *

Lieut. R. G. Penoyer, Naval Aviation, has received his orders to proceed to Germany in connection with the construction of a large commercial airship for the Navy. He will leave this country in February, prohably with Comdr. Z. Lansdowne who will relieve Lt. F. P. Culbert, Asst. Naval Attaché for Aviation at Berlin, Germany, who has just returned from abroad and Lieutenant Fulton of the Aviation Construction section.

Conference on Nomenclature

A conference of government experts on aviation was called on Feb. 3 by Joseph S. Ames, of the National Advisory Committee for Aeronautics to revise the aeronautical nomenclature in accordance with a resolution of the Committee. Letters inviting the attendance of representatives were sent to the Army Air Service, the Naval Bureau of Aeronautics, the Bnreau of Standards, the Air Mail Service, the Society of Automotive Engineers, the American Society of Mechanical Engineers and the Aeronautical Chamber of Commerce.

It is believed that the meeting will be held within two weeks time, although a definite date has not been set. The standard terminology issued for aviators and those interested in aeronautics by the National Advisory Committee in 1919 will be revised and augmented with new terms and definitions.

McCook Field Asks for Bids

The Engineering Division, Air Service, at McCook Field, has asked aircraft constructors to submit competitive designs for a new type long range bomber to he powered with two 700 hp. engines and with ability to carry from 5,000 to 6,000 lb. of bombs, with a range of from seven to eight honrs.

The new bomber is intended for operations at sea against hostile warships. It is understood that awards on the designs will be made on April 5. Three machines are to be ordered from the company submitting the best design, in addition to a cash award. Additional cash awards are to be made to companies submitting other approved designs.

Swiss Soaring Competition

A soaring flight competition is to be held hy the central section of the Swiss Aero Clnb at Gstaad, Bernese Oberland, from March 8 to 15, 1922. In connection with this meeting a course in soaring flight instruction is being arranged on the site, beginning Feb. 15, next.

Fast Flight of Loening Flying Boat

A fast flight was made on Feb. 5 by former Lieut. Comdr. David McCulloch when he piloted a Loening Flying Yacht from Miami to Palm Beach, Fla., in 40 min. Pilot McCulloch carried as passengers Gen. T. Coleman Dupont, former Postmaster General Will H. Hays, and William Erb, an associate of Mr. Dnpont. The distance between Miami and Palm Beach is abont 90 miles.